Product Differentiation and State Promotion of Farm Produce: An Analysis of the Jersey Fresh Tomato*

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Abstract

Product differentiation, a prerequisite for successful state promotion of state branded farm products, may be reflected by differences in the own-price, cross-price and income elasticities of demand between a state's brand and other products. This paper tests for such differentiation by estimating demand functions for tomatoes available at the retail level in New Jersey. The "Jersey Fresh" brand is shown to have higher own-price and income elasticities of demand. It is thus perceived to be of higher quality than others. Consumers are also found to be origin biased. Promotion based on the Jersey Fresh's unique attributes and on encouraging further origin bias may have a good chance of success.

Introduction

There is growing interest among state governments in the United States in enhancing the competitiveness of locally produced farm products. Many state governments view the promotion of local farm products as a vehicle by which increased competitiveness and state market shares can be achieved.[1] Although information on the effectiveness of past promotional programs has

*New Jersey Agricultural Experiment Station Publication No. D-02260-1-90. This research was supported by State and federal funds appropriated under the Hatch Act. The authors appreciate the cooperation of Dan Rossi, the New Jersey Agricultural Experiment Station, Rutgers Cooperative Extension Service, participating tomato growers, Laurie Houston, Susan Howard, and the staff and management of Kings Supermarkets and William Consalo and Sons.

been limited, contradictory and rather inconclusive (Wolf, Halloran and Martin), several states have recently implemented new state promotional programs.[2] Many are still considering the possible merits and demerits of such programs.

Policymakers in states deliberating the implementation of these programs typically seek information on (a) the types of market characteristics and product attributes that are conducive to successful state brand promotion, (b) how unique or differentiated the promoting state's product is,[3] and (c) whether or not the net returns from promotion will in fact be positive (Halloran and Martin; Ward, Chang and Thompson; Morrison). In their attempts to provide useful information, agricultural economists have typically stayed away from the latter because potential returns to promotion are difficult to determine prior to implementing a promotional program. Instead, their focus has been on theoretical issues related to the former (Halloran and Martin; Ward, Chang and Thompson; Hoos).

It has been argued that one of the following three scenarios must exist for the promotion of a state's brand of a farm product to have a chance of success (Brumfield and Adelaja, Halloran and Martin). The first scenario is one where the promoted product is unique, has differentiating attributes, is of better quality, or is used for a unique purpose (Halloran and Martin). Under this scenario, promotion highlighting the unique attributes of the promoted product should stimulate sustained increases in consumer demand for the product vis-a-vis other states' products.[4] The benefits of promotion are expected to spill over to other (nonpromoting) states and to result in a free-rider problem if the promoted product is not unique. The argument that product differentiation is a necessary and sufficient condition for successful promotion has been challenged by recent studies (Brooker, Eastwood and Orr, 1987a; Eastwood, Brooker and Orr).

The second scenario is one where the promoting state has a large market share. In this case, farm income of the promoting state can still be increased significantly by promotion even when differentiating attributes are lacking (Waugh; Quilkey; Ward, Chang and Thompson). A large market share reduces the free-rider problem so that most of the benefits of promotion accrue to the promoter.

The third scenario is one where consumers are purely biased towards the product of a state. This scenario is hinged on the notion that origin of a product and other nonpecuniary or nonobjective factors are important when consumers make their purchase decisions (Brooker, Eastwood and Orr, 1987a; Brooker, et al., 1987b; New Jersey Department of Agriculture; Eastwood, Brooker and Orr). Under this scenario, promotion urging consumers to patronize a state's brand out of loyalty to local farmers, for example, is expected to encourage brand loyalty and increased use. This may be so even if the state's product is not unique in attributes and does not command a large market share.

The scenarios above underscore the need for prior information on the degree of uniqueness of an aspiring promoting state's product and the extent to which nonpecuniary factors such as product origin affect consumer demand. If pre-promotion data on consumer purchasing patterns are available, it is possible to econometrically determine if a state's product is unique and if nonpecuniary factors affect consumers' purchase decisions. Information obtained from such analysis could be used in deciding what to base promotional programs on. For example, it may be better for promotional programs to focus on attributes when the promoting state's product is determined to be unique. To economists, uniqueness implies, among other things, potential differences in own-price, cross-price and income elasticities of demand for the state's product, relative to other states' products. On the other hand, it may be better for promotion to focus on nonpecuniary characteristics such as origin if it is econometrically determined that consumers make their purchase decisions on the basis of such characteristics.

One state where there is a need to identify the uniqueness of the state's product is New Jersey where the state government wants to intensify the promotion of the "Jersey Fresh" tomato, its local brand. To date, there is little available information on the uniqueness of the product. In this paper, the differences in elasticities of demand between brands of tomatoes available to consumers in New Jersey are econometrically determined via a methodology that also allows for testing the impact of nonpecuniary factors on demand. The extent to which the locally grown "Jersey Fresh" tomato is different from other tomatoes available in the New Jersey market is delineated. The methodology and findings of this paper are potentially useful to economists, market researchers and policy analysts studying the promotion of farm products and to policy makers currently considering their implementation.

Conceptual Framework

The definitions of the words "grade" and "brand" as used in this paper are explained first. The former is used to describe a situation where classes of a product are clearly differentiated on the basis of quality and/or attributes alone and where the preference for a particular class is based solely on its superiority or unique attributes. The latter is used to describe a situation where the classes are identifiable and perceived to be different whether or not differences actually exist. That is, the perceived uniqueness may be "real" (in which case they are linked to attributes), "fancied" (in which case they are not linked to attributes), or a combination of both. Typically, a brand of a product will have unique attributes (better grade). In addition, however, consumers may patronize it for other reasons such as origin, food safety, desire for the exotic, or brand loyalty.

Because various grades of a product are substitutes, consumers' responsiveness to changes in prices are expected to differ for various grades (Tomek and Robinson). Specifically, the demand for a better quality or higher grade product should be more inelastic vis-a-vis its lower quality competitors because quality is more of a necessity to the higher income individuals who patronize quality products than to lower income consumers. That is, higher income individuals will tend to be less responsive to price changes than lower income individuals. Tomek and Robinson explained the relatively inelastic demand for a quality product by stating that for the same quantities of a premium and regular product, consumers will be willing to pay a higher price for the premium product.

Consumer responses to changes in income should also differ across grades (Tomek and Robinson). Specifically, a higher quality product should have a higher income elasticity of demand simply due to the greater preference of higher income individuals for premium products. Products of higher quality should also have a lower sum of cross-price elasticities (Tomek and Robinson). The rationale is that the higher the quality, the fewer the number of close substitutes.

The price premium associated with a quality product would ordinarily reflect the value of all quality attributes inherent in the product but lacking in a lower quality one (Jordan et al.). Price in excess of this ordinary premium (excess premium) may reflect brand loyalty, monopoly power, preference for products of a certain origin, pure preference bias or price discrimination (Rosen). In a competitive scenario where price discrimination and monopoly power are unlikely, the excess premium may reflect brand loyalty, preference due to product origin or pure preference bias. Econometric analysis of pre-promotion market demand can shed some light on whether or not an excess price premium exists.

To illustrate how product uniqueness can help determine which type of promotion is most promising, a distinction is made between generic and brand promotion. Generic promotion deals with a general class of a product and can yield significant payoffs to a promoting state only when the state has a commanding market share in the market in which it promotes (Halloran and Martin). Commanding shares of the market have been the basis of California, Florida and Idaho's national promotions of citrus and potatoes. Other states with low market shares typically engage in brand promotion in national and local markets.

Brand promotion promotes a sub-class, a grade or a special brand. The essence of product branding by states is to differentiate their products on the basis of quality attributes or nonpecuniary factors in order to improve the chances of success of brand promotion. If a state's product is truly unique, brand promotion selectively shifts the demand for the product while leaving aggregate demand untouched (market share increases). By making consumers more aware of the uniqueness of promoter's product, brand promotion can also make consumer demand more price inelastic and income elastic and reduce product substitutability. Brand promotion may be informative in the sense that where consumers falsely view two products to be the same when they should not, it may correct the false view.

When a promoting state has a unique product in terms of quality and attributes, brand advertising should have a good chance of success if it appeals to consumers' interest in the unique attributes (Halloran and Martin). However, without the unique attributes, brand promotion should have a limited chance of success. In the case where the promoting state's product is not unique but consumers respond to nonpecuniary characteristics such as origin, (own-price, cross-price and income elasticities of demand do not vary across brands but the demands for various brands exhibit differences in intercepts [pure preference bias]), brand promotion should have a chance of success.

To econometrically determine the differences in the structures of the demands for the various classes or brands of a product that are available in the market, the choice first must be made between alternative demand model specifications. At one extreme is a pure aggregate demand model with no differences in own-price, cross-price and income elasticities among classes, no differences in perception about attributes, and no differences in preferences. An alternative is an aggregate model with no differences in own-price, cross-price and income elasticities of demand, no differences in perception about attributes, but biases in preferences. Yet another alternative is a disaggregate model where all elasticities differ, where consumers recognize the differences in attributes, and where there are preference biases. What these three alternative demand specifications imply in terms of the chances of success of various types of promotion are discussed above. In the next section, a demand model which can be used to generate information on product uniqueness, origin bias and the chances of success of brand promotion is specified.

Theoretical Demand Model

Let Q_i be the quantity purchased of a general class of products consisting of a premium group (A) and a nonpremium group (B) by the i^{th} consumer who chooses either A or B. Let D_i be a binary choice variable such that $D_i = 1$ if the i^{th} consumer chooses from group A and $D_i = 0$ if he chooses from group B. Let P_i be the price paid for the product chosen. The price may apply either to group A or B. Let P_{ij} be the price paid by the i^{th} consumer for the j^{th} product that is a substitute for or a complement to the product in question ($j = 1, 2, \ldots, m$). Define I_i as the i^{th} consumer's income. Define the vector X of additional variables that affect the i^{th} consumer's demand such that $X = X_{il} = (X_{i1}, X_{i2}, \ldots, X_{ik})$ where there are k such variables. The elements of the X vector may include variables such as age, household size, education, consumer rankings of A and B on the basis of attributes, and taste related variables (Blaylock and Smallwood). Finally, assume that there are n consumers.

Assuming that a variant of the double log functional form is appropriate in the specification of demand functions for the product, the following system of demand equations can be specified for the premium and non-premium groups:

$$\begin{aligned} logQ_i &= \alpha_f + \beta_f logP_i \\ &+ \gamma_f logI_i + \sum_{j=1}^{m} \lambda_{jf} logP_{ij} \\ &+ \sum_{l=1}^{k} \eta_{lf} X_{il} + \epsilon_{if} \\ &\text{for each } f,\ f = (1,2) = (A,B) \end{aligned} \tag{1}$$

where α_f is the intercept for the f^{th} group, β_f is the own-price elasticity of demand for the f^{th} group, γ_f is the income elasticity of demand for the f^{th} group, λ_{jf} is the elasticity of demand for the f^{th} group with respect to the price of the j^{th} substitute or complement (cross-price elasticity), and η_{lf} is the percentage change in demand for the f^{th} group due to a change in the l^{th} exogenous factor that affects demand. The error term for the f^{th} group (ϵ_{if}) is assumed to be normally distributed with a mean of zero and a constant variance of

$\sigma^2_{\epsilon_{ij}}$. If $\alpha_1 \neq \alpha_2$, $\beta_1 \neq \beta_2$, $\gamma_1 \neq \gamma_2$, $\lambda_1 \neq \lambda_2$ for all j, and $\eta_{l1} \neq \eta_{l2}$ for all l, the groups have unequal elasticities and the impacts of any specific exogenous factor are not equal. Analysis of variance (Chow Tests) for differential intercepts, differential slopes and overall homogeneity are useful in choosing among the model in equation (1) and other models where some elasticities and measures do not change across groups. If one assumes no contemporaneous correlation, *OLS* or *GLS* estimate of each of the parameters in (1) will be unbiased and consistent. If, however, there is contemporaneous correlation, Zellner's seemingly unrelated regression technique is warranted (Zellner).

If the specification in equation (1) is accepted, a composite demand function that allows one to account for differential intercepts and slope (but in only one demand function) can be specified as follows:

$$\begin{aligned} logQ_i &= \alpha^* + \beta^* logP_i + \\ &\gamma^* logI_i + \sum_{j=1}^{m} \lambda_j^* logP_{ij} + \sum_{l=1}^{k} \eta_l^* X_{il} \\ &+ \rho^* D_i + \beta^+ (logP_i)(D_i) \qquad (2) \\ &+ \gamma^+ (logI_i)(D_i) + \sum_{j=1}^{m} \lambda_j^+ (logP_{ij})(D_i) \\ &+ \sum_{l=1}^{k} \eta_l^+ (X_{il})(D_i) + \epsilon_i^* \end{aligned}$$

where ϵ_i^* is assumed to have a mean of zero and a variance of $\sigma^2_{\epsilon_i^*}$. If $D_i = 0$, the intercept $= \alpha^*$,

$$\partial logQ_i / \partial logP_i = \beta^*,$$

$$\partial logQ_i / \partial logI_i = \gamma^*,$$

$$\partial logQ_i / \partial logP_{ij} = \lambda_j^*, \text{ and}$$

$$\partial logQ_i / \partial X_{il} = \eta_l^*.$$

If, however, $D_i = 1$, the intercept is $\alpha^* + \rho^*$,

$$\partial logQ_i / \partial logP_i = \beta^* + \beta^+,$$

$$\partial logQ_i / \partial logI_i = \gamma^* + \gamma^+,$$

$$\partial logQ_i / \partial logP_{ij} = \lambda_j^* + \lambda_j^+, \text{ and}$$

$$\partial logQ_i / \partial X_{il} = \eta_l^* + \eta_l^+.$$

Thus, ρ^*, β^+, γ^+, λ_j^+, and η_l^+ are the differences in the impacts of causal variables on Q_i.

The model in equation (2) is a composite model with slope containing binary variables. Ben-David and Tomek suggested this type of model for estimating structural break. It may in fact be a good starting point in model specification since it would indicate which types of structural differences exist. The advantage of the composite model is that it can be used when data are insufficient to estimate separate demand functions.[5] An obvious problem to expect in estimating the model is multicollinearity due to the presence of slope shifter variables (collinearity between $[logI_i]$ and $[logI_i][D_i]$, for example).[6] Another is degrees of freedom problem as the specification increases the number of exogenous variables in the estimated equation. In the next section, the models outlined above are applied to data obtained via a survey of fresh tomato purchasers at the retail level in New Jersey in order to determine the uniqueness of the Jersey Fresh tomato.

Application to New Jersey Data

In the fresh tomato retail market in New Jersey, there are competing products from New Jersey, California, Florida, Holland, Israel, Mexico and other states. The non-Jersey tomatoes are picked green, packed neatly, shipped to New Jersey locations, and ethylene gassed before arriving in New Jersey markets to force them to ripen prematurely. New Jersey growers have the advantage of proximity to the market (Lopez and Munoz) which allows them to offer good quality, mature, fresh and vine-ripened tomatoes in the New Jersey, Pennsylvania and New York markets. Some studies have argued that this product is of better quality than most other tomatoes (New Jersey Department of Agriculture).

The New Jersey Department of Agriculture decided to initiate a branding and promotional program in the early 1980s in support of its fresh farm produce (including tomatoes). Since then, the "Jersey Fresh" program has involved advertising via a variety of media (including television and billboards) and points of purchase promotional programs. A poll conducted by the Gallop organization in late 1984 to evaluate the success of the "Jersey Fresh" program revealed that 60 percent of the respondents indicated that New Jersey farm produce are fresher than others while 66 percent indicated that they would be more inclined to purchase New Jersey farm produce if branded as such (New Jersey Department of Agriculture). Lininger argued that these percentages indicate that some of the purchasers are swayed by non-pecuniary factors (pure preference bias).[7]

To assess consumer response to the Jersey Fresh tomato and the nature of the uniqueness of the product, a survey of produce purchasers at four stores in the Kings Super Markets retail food chain in Northern New Jersey was conducted in the late summer and fall of 1988. All interviews took place simultaneously in all four stores on Thursdays, Fridays and Saturdays. A total of 757 interviews were conducted, 522 of which purchased at least one type of tomato. Total quantities purchased in pounds (QT_i), price paid (P_i), prices of other tomatoes (P_{ij}), as well as other information to be discussed below were noted. Four people purchased three types of tomatoes, twenty-six purchases two types and non-purchasers totaled 235.

The prices of tomatoes varied significantly by design. For example, six different prices were observed for the Jersey Fresh tomato while eight different prices were observed for other tomatoes. The Jersey Fresh tomato classes included the premium and standard classes which are different only in terms of price and uniformity in size, shape and color. The non-Jersey tomatoes at the time of the survey included Holland, Florida, plum, cherry, salad, California and Connecticut tomatoes.

Demographic data were also collected on family income (FI_i), total amount spent on food items on the interview date (S_i), years of education completed by purchaser (ED_i), family size (FS_i), age of purchaser (AGE_i), race of purchaser ($RACE_i = 1$ if minority, $RACE_i = 0$ otherwise), and sex of purchaser ($SEX_i = 1$ if male, $SEX_i = 0$ otherwise). In addition, consumers were asked if they thought the Jersey Fresh tomato was better or worse than others (ranking variables) in terms of taste (TAS_i), appearance (APP_i), storage life (STO_i), value or price (VAL_i), nutrition (NUT_i) and overall ($ORANK_i$). $ORANK_i$ represents the overall ranking of the Jersey Fresh tomato in contrast to other tomatoes. The ranking variables were transformed into binary variables (e.g., $NUT_i = 1$ if better, $NUT_i = 0$ otherwise).

Consumers were also asked to rank which attributes of tomatoes were very important, important or unimportant in their decisions to purchase tomatoes. The attributes included color (COL_i); size (SIZ_i); uniformity in size, color, and shape (UNI_i); lack of blemishes (BLE_i); firmness (FIR_i); ripeness or maturity (RIP_i); value (VAL_i); package size (PAK_i); and origin of product ($ORIG_i$). For econometric purposes, the responses were measured as follows: $COL_i = 1$ if color is unimportant, $COL_i = 2$ if color is important, and $COL_i = 3$ if color is very important.

Non-purchasers were excluded in the estimation of equations (1) and (2) because the log of Q_i could not be constructed for these consumers.[8] The exclusion of non-purchasers did not pose a serious problem because most non-purchasers were actually tomato purchasers but not on the day of the survey (only 8 out of 235 nonpurchasers said that they never purchase tomatoes). Purchasers of more than one item were included in the data used in estimating equation (1). These numbered 453 because there were 69 individuals with incomplete information. Only data on purchasers of only one item (423 observations) were included in the estimation of equation (2) because of difficulties in calculating Q_i, P_i and P_{ij} for multiple item purchasers.

For single item purchasers, the variables in equations (1) and (2) were constructed as follows. The dependent variable (Q_i) was measured as

QT_i/FS_i. Price paid (P_i) was measured as the unit price of the product bought whether Jersey Fresh or other. Price of substitute (P_{ij}) was measured as the weighted average price of all other tomatoes in the same store in the same day (if the Jersey tomato was bought) and as the price of the Jersey tomato (if another type of tomato was bought). Since the prices of substitutes and complements for tomatoes did not vary across stores, these were excluded from the P_{ij} vector.[9]

For the 30 multiple item purchasers, data on which were included in the estimation of equation (1), the variables were constructed as follows. In the case of consumers who purchased Jersey fresh and one non-Jersey fresh item, Q_i in the Jersey fresh equation was measured as the quantity of Jersey fresh bought while Q_i in the non-Jersey fresh equation was measured as the quantity of the non-Jersey fresh item bought. P_i was measured as the price of Jersey fresh in the Jersey fresh equation and as the price of the non-Jersey fresh item bought in the non-Jersey fresh equation. P_{ij} was measured as the price of the non-Jersey fresh item bought in the Jersey fresh equation and as the price of the Jersey fresh in the non-Jersey fresh equation. In the case where more than one non-Jersey fresh item is bought, Q_i is measured as the weighted average quantity bought, P_i is measured as the weighted average price paid for the non-Jersey items in the non-Jersey fresh equation, and P_{ij} is measured as the weighted average price paid for the non-Jersey items in the Jersey fresh equation.[10] Income (I_i) was measured as FI_i/FS_i.

Several models involving a broad range of independent variables were estimated in an attempt to discriminate among important and unimportant variables. All demographic variables (ED_i, SEX_i, AGE_i, and $RACE_i$) except Income (I_i) were found not to significantly affect Q_i at the 5 or 10 percent levels of significance. Variables related to the ranking or comparison of tomatoes on the basis of attributes were generally not significant individually at the 5 percent level (TAS_i, APP_i, STO_i, VAL_i, and NUT_i). The overall ranking variable ($ORANK_i$), however, was significant at the 5 percent level when it was used in the place of the individual ranking variables. The origin variable ($ORIG_i$) was the only variable among the variables measuring what consumers consider to be important that was consistently found to be significant at the 5 percent level. The final specification of equation (1) which was chosen was of the form:

$$\begin{aligned} logQ_i &= \alpha_f + \beta_f logP_i + \gamma_f logI_i \\ &+ \lambda_f logP_{ij} + \eta_{1f}\, ORANK_i \\ &+ \eta_{2f} ORIG_i + e_{if},\ for\ each\ f,\ f = (1,2). \end{aligned} \tag{3}$$

Note that all variables which were dropped before settling for equation (3) were included in other variations of the demand model before they were also finally dropped in those models. Chow tests were used to confirm the validity of the specification in equation (3).

The composite alternative to (3) with binary variables for differential intercepts and slopes was of the form:

$$\begin{aligned} logQ_i &= \alpha^* + \beta^* logP_i + \gamma^* logI_i \\ &+ \lambda^* logP_{ij} + \eta_1^* ORANK_i \\ &+ \eta_2^* ORIG_i + \rho^* D_i + \beta^+ (logP_i)(D_i) \\ &+ \gamma^+ (logI_i)(D_i) + \lambda^+ (logP_{ij})(D_i) \\ &+ \eta_1^+ (ORANK_i)(D_i) + \eta_2^+ (ORIG_i)(D_i) + e_i^*. \end{aligned} \tag{4}$$

$D_i = 1$ for Jersey fresh and $D_i = 0$ otherwise. Equation (4) was estimated by GLS to account for heteroscedasticity problems while the system of equations in (3) was estimated by the Iterative Zellner's seemingly unrelated regression technique (ITZSUR).

Empirical Results

Parameter estimates for the system of equations in (3) are reported in Table 1. The low R-squares are typical of cross-sectional data sets. All coefficients are significant at the 10 percent level. Only one coefficient is insignificant at the 5 percent level. All signs for elasticity terms are theoretically consistent. That is, both types of tomatoes have negative own-price elasticities, both exhibit substitutability with the other types of tomatoes, and tomatoes are normal goods. The magnitudes of the coefficients also seem to be consistent with expectations.

Table 1

Parameter Estimates of Equation 3

R-Square	Sample Size (n)	Residual Sum of Squares (RSS)	Variable	Coefficient	Parameter Estimate[a]
			Jersey Fresh		
0.1823	453[c]	58.2177	Intercept[b]	α_1	0.4375
			$logP_i$	β_1	-0.1308
			$logI_i$	γ_1	0.3625
			$logP_{ij}$	λ_1	0.0327
			$ORANK_i$	η_{11}	0.0632
			$ORIG_i$	η_{21}	0.1247
			Other Tomatoes		
0.1312	453[c]	46.2736	Intercept	α_2	0.3374
			$logP_i$	β_2	-0.2245
			$logI_i$	γ_2	0.2573
			$logP_{ij}$	λ_2	0.0937
			$ORANK_i$	η_{12}	-0.0244
			$ORIG_i$	η_{22}	-0.0895′

[a]All coefficients were significant at the 10% level. Single prime indicates insignificance at the 5% level.

[b]Homogeneity and Engle aggregation conditions were not imposed because the P_{ij} variable does not represent the full range of alternative products in the consumer budget. Slutsky Symmetry (Holling-Jureen) conditions were not imposed because the shares of consumer budget devoted to both types of tomatoes were unknown.

[c]To facilitate the use of the Zellner's method of estimation, when $Q_i = 0$ in the case of single item purchasers, it was approximated by 1×10^{-6}.

The fact that the estimate of β_1 is lower than that of β_2 in absolute terms suggests a more inelastic demand for the Jersey Fresh tomato. The higher γ_1 estimate than γ_2 also suggests a higher income elasticity for the Jersey fresh tomato. The lower λ_1 value, vis-a-vis λ_2, also suggests that substitutability for Jersey Fresh is more limited than for other tomatoes. The fact that η_{11} is positive and η_{12} is negative suggests that people who rank the Jersey Fresh tomato as better bought more of it but less of the other types of tomatoes. The fact that η_{21} is positive and η_{22} is negative suggests that those who said origin was important in their purchasing decision bought more of the Jersey Fresh tomato but fewer of other types.

The Chow test for overall homogeneity (that all slopes and intercepts are different) was used to test the hypothesis that the coefficients of the demand functions in equation (3) differ across equations. The test requires estimating an aggregate demand model with no differences in own-price, cross-price and income elasticities, no differences in perceptions about attributes and no differences in intercept. The aggregate model, which requires the use of all available data on all consumers, is similar to equation (4) but excludes slope shifters. The F-statistic for that test is (Pindyck and Rubinfeld):

$$F^{(k+m+3)}_{n-2(k+m+3)} = \frac{(RSS - \sum_{f=1}^{2} RSS_f)/(k+m+3)}{(\sum_{f=1}^{2} RSS_f)/(n-2\{k+m+3\})} \tag{5}$$

where RSS is the residual sum of squares from the aggregate model, the values of RSS_f are the residual sums of squares from equation (3) and $k + m + 3$ is the number of coefficients to be estimated. The F-test for overall homogeneity yielded an F-statistic of 6.1726 for (6ndf and 441ddf). It therefore supports the specification in equation (3) at even the 1 percent level of significance. Thus, separate demand equations for the Jersey Fresh tomato and other tomatoes are justified. The result of the F test demonstrates the uniqueness of the Jersey Fresh product in the New Jersey Fresh tomato market.

From equation (4), β^+ is expected to be positive but less than β^* while α^+ is expected to be positive. γ^+ is expected to be positive while λ^+ is expected to be negative but less than λ^*. If the Jersey Fresh product has superior attributes, η_1^+ should be positive while η_1^* can be positive or negative. However, the absolute value of η_1^+ must be greater than that of η_1^* if η_1^* is negative. The same applies to the relationship between η_2^+ and η_2^* if consumers are origin biased.

Parameter estimates of equation (4) are reported in Table 2. The R-square measure is significantly higher than those of the equations in the system in (3). The residual sum of squares (RSS^+) is lower than RSS_1 but about equal to RSS_2. The relative closeness of RSS_1 and RSS_2 suggests that the assumption upon which equation (4) is based (that the variance of the error terms for the two classes are not different) may be valid.[11]

As shown in Table 2, the Jersey Fresh tomato has an additional intercept term of 0.0725 which brings its intercept to 0.4500, as opposed to 0.3775 for other tomatoes. This confirms the finding of a preference bias towards the Jersey Fresh tomato from the estimation of equation (3). The full disaggregate model [equation (3)] yielded an intercept of 0.4375 for the Jersey Fresh and 0.3374 for other tomatoes. The Jersey Fresh tomato has an additional own-price elasticity term of 0.0661 which brings its elasticity to -0.1351, compared with -0.2012 for other tomatoes (for comparison, β_1 and β_2 were respectively -0.1308 and -0.2245). Thus, both the models in equation (3) and (4) suggest that the Jersey Fresh tomato has a more price inelastic demand.

Table 2

Parameter Estimates of the Composite Demand Model

Variable	Coefficient	Parameter[a] Estimate	Variable	Coefficient	Parameter Estimate
Intercept	α^*	0.3775	D_i	ρ^*	0.0725
$logP_i$	β^*	-0.2012	$(logP_i)(D_i)$	β^+	0.0661
$logI_i$	γ^*	0.2023	$(logI_i)(D_i)$	γ^+	0.0427
$logP_{ij}$	λ^*	0.0947	$(logP_{ij})(D_i)$	λ^+	0.0212′
$ORANK_i$	η_1^*	-0.1812	$(ORANK_i)(D_i)$	η_1^+	0.0775
$ORIG_i$	η_2^*	0.0021	$(ORIG_i)(D_i)$	η_2^+	0.0720

Sample size (n) = 423

R-Square (R^2) = 0.3056

Residual sum of squares (RSS^+) = 46.4520

[a]All coefficients were significant at the 10% level. Single prime indicates insignificance at the 5% level.

The Jersey Fresh tomato has an additional income elasticity term of 0.0427 which brings its income elasticity to 0.2450, compared with 0.2023 for other tomatoes (for comparison, γ_1 and γ_2 were 0.3625 and 0.2573). This, again, is consistent with the findings from the model in equation (3). The additional cross-price elasticity term for the Jersey Fresh tomato was not significant in equation (4). However, the estimated cross-price elasticity for other tomatoes was 0.0947.

Both of the *ORANK* coefficients were also significant in the composite model and were of the expected signs and magnitudes, suggesting that there is an attribute linked preference for the Jersey Fresh product. However, while both of the *ORIG* coefficients were significant, both signs were positive with the η_2^+ coefficient exceeding the η_2^* coefficient. This is consistent with economic theory and with the results from the estimation of equation (3). The η_2^+ and η_2^* coefficients from equation (4) suggest that origin plays a role in the demand for Jersey Fresh tomatoes.

To test for heteroscedasticity in equations (3) and (4), Park-Glejser tests were performed. The tests involved testing the hypothesis that the error term was correlated with each of the independent variables. Results of the tests suggested that heteroscedasticity was not a serious problem (see Glejser and Park for a description of the Park-Glejser test). Due to the large sample size and and the high number of significant coefficients, problems related to multicollinearity were ignored in both equations.

Summary and Conclusions

To detect product differentiation among brands of tomatoes available in New Jersey for the purpose of assessing the chances of success of brand promotion of the Jersey fresh tomato, this paper econometrically estimates demand functions for tomatoes available in New Jersey based on cross-section data. The methodology can be applied by other states interested in assessing the uniqueness of their products and in detecting the existence of origin based biases in favor of their products. The Jersey fresh tomato seems to have a more inelastic demand with respect to price, a more income elastic demand function and fewer substitutes relative to other products. The uniqueness of the Jersey Fresh product implies that brand promotion of the product may have a good chance of resulting in improved market share.

The results also suggest that some of the preferences for the Jersey fresh tomato are due to its superior attributes and the fact that it is grown in New Jersey. This implies that the product can be promoted not only on the basis of its attributes but also by appealing to the preference among consumers for locally grown produce due to its attributes, reputation and origin. Perhaps the next step in New Jersey is to determine if returns to the advertising of the product has been positive. This will require time series data which at this time are not sufficiently available, and information on advertising expenditures.

Endnotes

[1]State governments have been promoting their locally grown farm produce since the early 1930s (Wolf). Pressure from political interest groups, concerns about incomes of state farmers, and the desire to bolster state market shares of specific agricultural products motivated the implementation of most promotional programs. Growing interest in these programs in recent years can be attributed to the recent agricultural recession in the U.S. and the transfer by the federal government of much of the responsibilities for state farm sectors to state governments.

[2]Examples of promoting states include California, Florida, New Jersey, Massachusetts, Virginia, Georgia, Illinois, Oregon, Michigan and New York.

[3]Product uniqueness or differentiation is seen as a condition under which the promotion of a state's product has a chance of success (Halloran and Martin).

[4]If a product promoted on the basis of its attributes is not unique, the promotion is deceptive. Deceptive advertising has limited chance of continued success (Ward, Chang and Thompson).

[5]The model in equation (2) is similar to piece-wise linear regression models discussed by Pindyck and Rubinfeld and is a special case of Spline functions discussed by Suits et al., Poirier, and Barth et al. It assumes a continuous demand function with respect to each explanatory variable and the existence of a structural difference between demands for various brands.

[6]The model in equation (2) also assumes that the variance of the error term is identical for classes or brands of a product. Least squares estimates of the coefficients and their standard errors will be unique and unbiased. However, the variances may be high but consistent while the coefficients themselves remain unbiased if multicollinearity is present.

[7]Lininger argued that the observed preference for the Jersey Fresh brand may be due to the fact that the product has been promoted.

[8]The elimination of non-purchasers increases the chances of sample selection bias as the full range of consumer behavior may not be captured in the estimation of the demand functions.

[9]The prices of possible complements and substitutes were held constant across stores by design. This was possible because all stores in which surveys were conducted were stores in the Kings supermarket chain. Tomato prices were allowed, however, to vary by design.

[10]The weights used were the shares of total expenditure on non-Jersey Fresh tomatoes that are attributable to a particular non-Jersey Fresh brand.

[11]The model in equation (3) allows for differences in the variances of the error term between two classes of products while equation (4) assumes similar variances. If one is willing to assume or one has prior information that the variances are the same, one can proceed to equation (4) without estimating equation (3) or less disaggregate models first.

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